

CLAIMS

1. A cornerplate-less duct which has a tubular shape with a rectangular cross-section, the duct comprising:

a plurality of plate members joined to each other at side end portions thereof by seam joints, in which flange portions which are connecting faces adapted to connect adjacent ducts are formed integrally at a starting end portion and a terminal end portion of a plate formed into each plate member by bending the plate in a direction substantially perpendicular to a longitudinal direction of the plate, corner forming portions are formed to protrude outward from side ends of the flange portions in a width direction of the plate, and the corner forming portions of adjacent plate members are overlapped with each other to form corner portions of the flange portions of the duct in an assembled state;

wherein the plate is structured such that a first cut portion is formed in a portion which is closer to a center in the longitudinal direction of the plate than a starting end or a terminal end of the plate such that the first cut portion extends in the width direction of the plate and has a depth substantially equal to an overlapping portion of the corner portion.

2. The cornerplate-less duct according to claim 1, wherein a dimension in a width direction of a portion of the plate which is closer to the center than the first cut portion is substantially equal to a sum of a dimension of a wall forming portion of the duct and a dimension of seam forming portions on both sides of the wall forming portion, and a dimension in a width direction of a portion of the plate which is closer to the starting end

or the terminal end than the first cut portion is substantially equal to a sum of a dimension in a width direction of a flange forming portion formed into the flange portion and a protruding dimension of the corner forming portions.

3. The cornerplate-less duct according to claim 1 or claim 2, wherein the protruding dimension of the corner forming portions is substantially equal to a width of the connecting faces of the flange portions of the adjacent plate members in an assembled state of the duct.

4. The cornerplate-less duct according to any one of claims 1 to 3, wherein the corner forming portions of plates are provided with fixing holes at a location where the corner portions of adjacent plate members overlap with each other to allow the fixing holes to conform to each other in an assembled state of the duct.

5. The cornerplate-less duct according to claim 4, wherein an engagement portion which is bendable is provided integrally with the fixing hole.

6. The cornerplate-less duct according to any one of claims 1 to 5, wherein the plate has a second cut portion which is closer to the center in the longitudinal direction than the first cut portion.

7. A method of manufacturing a cornerplate-less duct according to claim 1, comprising:

(a) temporarily bending the corner forming portion of the plate by a predetermined angle in an opposite direction to bending of a seam forming portion located closer to the center than the first cut portion;

(b) forming the seam joint portion at a seam forming portion using a seam forming apparatus;

(c) returning the temporarily bent corner forming portion to an original state after the seam joint portion has been formed; and

(d) processing the starting end portion or the terminal end portion in the longitudinal direction of the plate using a seam forming apparatus, thereby forming the flange portions of the duct and the corner forming portions protruding laterally from the flange portions.

8. A seam forming apparatus of a cornerplate-less duct comprising:

plural forming roll pairs arranged in a flow of a forming process, the apparatus being configured to sequentially pass a plate between forming rolls of each of the plural forming roll pairs to form seam joint portions at side end portions adapted to connect plate members forming the cornerplate-less duct having a rectangular cross-section, the plate having corner forming portions at both side end portions of a wall forming portion of the duct, the corner forming portion being a corner portion in the assembled state of the duct and being located with a cut portion interposed between the seam forming portion and the corner forming portion in a direction in which the plate is traveled, wherein rotation shafts

of at least the forming roll pair which is located at an upstream end in the flow of the forming process are oriented in X-direction which is perpendicular to the direction in which the plate is traveled, and the forming rolls of the forming roll pair are cantilever-mounted to the rotation shafts;

press rolls each of which is disposed such that an outer peripheral face of the press roll makes contact with an end face on a free end side of one of the forming rolls of each forming roll pair, the press rolls having rotation shafts extending in a Y-axis direction perpendicular to the rotation shafts of the forming rolls and the direction in which the plate is traveled, wherein a non-forming process region is formed in a space ranging from a free end of an opposite forming roll of the forming roll pair to a position apart from the free end, and a plate support face on which the plate is supported is provided on upstream side of the forming roll pair such that a boundary face between the press roll and the corresponding forming roll is an upper face of the plate support face; and

a guide member configured to guide a side end portion of the plate placed on the plate support face, which is to be subjected to a seam joint forming process, along the direction in which the plate is traveled.

9. The seam forming apparatus according to claim 8, wherein the guide member is placed such that a clearance is formed between the guide member and the plate support face to allow the plate member to be inserted therebetween,

the guide member has an edge-shaped end portion which is located

closer to a center of the plate to be guided, and

the seam forming portion of the plate is adapted to be positioned in the clearance formed between the guide member and the plate support face and the corner forming portion of the plate is adapted to be positioned on an opposite side of the clearance with respect to the guide member.

10. The seam forming apparatus according to claim 8 or 9, further comprising:

a bending device mounted in the vicinity of the guide member and configured to bend both of or one of the corner forming portion and the seam forming portion of the plate so as to form different angles with respect to the wall forming portion of the duct to allow the corner forming portion to pass through the non-forming process region ranging from the free end of the opposite roll of the forming roll pair to the location apart from the free end.

11. The seam forming apparatus according to any one of claims 8 to 10, further comprising:

a corner forming portion separating device mounted adjacent an upstream side of the guide member with a clearance between the separating device and the plate support face to allow the plate to pass therethrough,

wherein the separating device is structured such that an upstream end portion and an end portion closer to a center of the plate are edge-shaped and have a width smaller than a depth of a cut portion

between the corner forming portion and the seam forming portion, and the separating device is mounted such that the upstream end portion is substantially in contact with the plate support face when the plate is not positioned in the clearance and the upstream end portion is located above the plate support face when the plate is positioned in the clearance.

12. The seam forming apparatus according to claim 11, wherein the bending device is positioned downstream of the guide member and is positioned upstream of the forming roll pair.

13. A duct manufacturing apparatus comprising:

plural forming roll pairs arranged in a flow of a forming process, the apparatus being configured to sequentially pass a plate between forming rolls of each of plural forming roll pairs to form seam joint portions at side end portions adapted to connect plate members forming a cornerplate-less duct having a rectangular cross-section; wherein the forming roll pairs are each composed of forming rolls having rotation shafts and are mounted on a base such that the rotation shafts are oriented in X-axis direction perpendicular to a direction in which the plate is traveled;

a press roll mounted for one of the forming rolls of at least one forming roll pair, which is adapted to make contact with a duct wall forming portion of the plate such that a rotation shaft of the press roll is oriented to have a crossing angle with respect to the direction in which the plate is traveled and the X-axis direction, the plate being held between the

press roll and an end face of the forming roll with which the press roll is substantially in surface contact; and

a drive feed roll pair mounted at a location apart from the press roll in a direction from a portion of the plate which is being processed toward the duct wall forming portion and configured to forcibly feed the plate in the flow of the forming process with the plate sandwiched from both sides.

14. The duct manufacturing apparatus according to claim 8 or 13, further comprising:

a drive means configured to drive the rotation shafts of the forming rolls of at least one forming roll pair and the press roll mounted to correspond to the forming roll.

15. The duct manufacturing apparatus according to claim 13, wherein the rotation shaft of the press roll is oriented in Y-axis direction substantially perpendicular to the direction in which the plate is traveled and the X-axis direction.

16. The duct manufacturing apparatus according to claim 13, further comprising: a drive means configured to drive rotation shafts of the forming rolls of the forming roll pairs and the press rolls respectively mounted to correspond to the forming roll pairs.

17. The duct manufacturing apparatus according to any one of claims 13 to 16, wherein the rotation shaft of one of the forming rolls of the forming

roll pair is fixed on the base, the apparatus further comprising:

an elastic pressing means configured to elastically press an opposite forming roll toward the one forming roll.

18. The duct manufacturing apparatus according to any one of claims 13 to 17, wherein an end face on a press roll side of the rotation shaft of the forming roll adapted to contact a portion of the plate to be unprocessed is substantially as high as or lower than an end face of the forming roll which is adapted to contact the press roll.

19. The duct manufacturing apparatus according to any one of claims 13 to 18, wherein an end face of the rotation shaft corresponding to the forming roll which is opposite to the forming roll adapted to contact the wall forming portion of the duct, the end face being located on a side where the forming roll is attached, is configured not to substantially protrude from an end face of the forming roll.

20. The duct manufacturing apparatus according to any one of claims 13 to 19, further comprising an elastic pressing means configured to elastically press the press roll toward the forming roll adapted to contact the duct wall forming portion of the plate.

21. The duct manufacturing apparatus according to any one of claims 13 to 20, wherein the plurality of forming roll pairs arranged in the flow of the forming process include a punch forming roll pair configured to

advance to a plate processing region to punch the seam forming portion of the plate to form an engagement portion.